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ABSTRACT

Considerable interest in consolidation or reorganization of school districts derives from the perception that consolidation produces significant cost savings due to scale economies in the provision of education. This paper examines potential cost savings from consolidation of New York school districts--an initiative actively encouraged by the State. It extends past research on consolidation by developing a theoretical framework that distinguishes several dimensions of economies of scale and defines an empirical cost function for schooling. Data were used from 610 of 696 New York school districts in 1990 (omitting New York City, among others). The results indicate potentially sizeable cost savings from consolidation of districts with fewer than 500 pupils. Using such districts as candidates for consolidation, the study examines in detail the implications of merging these districts with a neighboring district. Findings reveal that relatively few New York districts are strong candidates for full consolidation, although some may benefit from sharing of administrative and support functions. The estimated cost model also sheds light on potential diseconomies associated with large urban school districts. While findings apply directly to New York, the method developed here has general relevance to state education policy by helping to target school districts as candidates for consolidation, and, where consolidation is not feasible, adjusting state aid formulas to reflect more accurately the cost impacts of scale. Contains 38 references and 8 data tables and figures. (Author/SV)

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POTENTIAL COST SAVINGS FROM SCHOOL DISTRICT CONSOLIDATION: A CASE STUDY OF NEW YORK

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POTENTIAL COST SAVINGS FROM SCHOOL DISTRICT CONSOLIDATION: A CASE STUDY OF NEW YORK

Abstract

The early 1990s have been a time of fiscal stress for local governments in the United States with school districts particularly hard hit. This article presents the results of a detailed study of potential cost savings from consolidation of New York school districts. It extends past research on consolidation by developing a theoretical framework which distinguishes several dimensions of economies of scale and defines an empirical cost function for schooling. The results of estimating the model indicate potentially sizeable costs savings from consolidation of districts with fewer than 500 pupils. Using such districts as candidates for consolidation, the study examines in detail the implications of merging these districts with one of their neighbors and finds relatively few districts strong candidates for full consolidation in New York, although some may benefit from sharing of administrative and support functions. The estimated cost model also sheds light on potential diseconomies associated with large city school districts. While findings apply directly to New York, the method developed here has general relevance to state education policy by helping to target candidate school districts for consolidation, and, where consolidation is not feasible, adjusting state aid formulae to reflect more accurately the cost impacts of scale.

POTENTIAL COST SAVINGS FROM SCHOOL DISTRICT CONSOLIDATION: A CASE STUDY OF NEW YORK

The early 1990s have been a period of fiscal stress for local governments in the United States with federal aid declining, tax revenue stagnant, and little increase in state aid as states attempt to cope with their own revenue shortfalls.[1] The fiscal plight of school districts epitomizes this situation with slow growth in both state aid and property tax revenues. In this tight fiscal environment, state governments, which fund half of school district budgets (U.S. Bureau of the Census, 1992), as well as local school districts have been searching for ways to improve economic efficiency of local schools .

One initiative that has received considerable attention is consolidation or reorganization of school districts. Such interest derives from the perception that there are significant cost savings from consolidation of small school districts due to scale economies in the provision of education. New York State, for example, has actively encouraged consolidation of small school districts and local governments through provision of additional operating and capital aid to consolidating governments.[2] Despite a substantial literature on economies of scale in education, there is little consistent evidence on whether school district consolidation saves money while maintaining educational quality.[3]

The objective of this article is to present results of a detailed study of potential cost savings from consolidation of New York school districts. The next section improves on past research on consolidation by developing a theoretical framework for evaluating the costs of providing public services. The conceptual model provides a basis for a comprehensive definition of various elements of economies of scale in education. This model is used to estimate an empirical cost function which identifies potential cost savings from school district consolidation in New York. The results of this analysis indicate potentially sizeable costs savings from consolidation of districts with fewer than 500

pupils. As regards possible diseconomies associated with large city school districts, evidence here indicates relatively small diseconomies of scale even for the largest district in the sample (50,000 pupils). Using districts with 500 or less pupils as potential candidates for consolidation, the study examines in depth the implications of merging these districts with one of their neighbors. Findings indicate that relatively few districts in New York are strong candidates for full consolidation, although 43 districts might benefit from sharing of administrative and support functions. The paper concludes with a discussion of the implications of these findings for state education policy and distribution of state aid for local schools.

Education Production, Costs and Economies of Scale

Before analyzing economies of scale in education, it is important to develop a conceptual framework to guide the analysis and interpretation of results. To date, results of extensive research on economies of scale in education, have been inconsistent due in part to lack of a "theoretical base" (Fox, 1981, p. 273). A major shortcoming has been the treatment of expenditure differences as indicators of cost differentials despite failure to control adequately for educational outcomes. The theoretical model developed in this study is informed by the extensive research on local public expenditure and on the determinants of student achievement.[4] A model of educational production which relates student achievement to school resources and socio-economic factors is derived and serves as the basis for the cost model from which estimates of scale effects are estimated.

A Model of Education Production

The provision of public education is a complex process involving many actors and types of resources. Education researchers over the last several decades have been trying to understand the key factors that affect student achievement. How important are school versus family background factors

and how can schools most effectively utilize their scarce resources? One commonly employed framework for modeling the education process is that of production theory in economics. This body of theory models the behavior of a firm or other enterprise in deciding what to produce, at what quantities and with what resources.

While general production theory is a solid foundation, considerable modification is required for its application to the special features of the production and provision of such public services as education. In principle, the production process in a school district can be modelled similarly to that of a private firm. The school district acquires and employs various school inputs to produce a range of educational activities (G). School districts, like firms, vary both in size (number of students served) and in the extent to which inputs are used centrally or distributed to their subunits (schools and ultimately classrooms). This production process can be modelled with a simple implicit production function:

$$G = f(L_T, L_P, K, Z) \quad , \tag{1}$$

where L_T represents teachers, L_P, other professional and para-professional staff, K, capital equipment and facilities, and Z, other factor inputs such as materials and utilities.

To be consistent with models of private firms, the output (G) of this production function is defined to represent direct services or activities provided by schools. It is theoretically possible to estimate a production function of this sort, and, when outputs can be expressed as physical units (e.g., tons of garbage collected) practically possible as well. Unfortunately, for services such as education it is extraordinarily difficult to measure outputs which represent quantities of activities of equivalent quality (e.g., classrooms hours at a given level of instruction). Most attempts to measure the quantity of output produced by a school have employed bundles of inputs such as "equivalent teacher hours" which assume, by definition, equal productivity of inputs across school districts. Here, the approach

is to measure output in terms of service outcomes, i.e. student test scores, and to define (estimate) the relationship between these output measures and school inputs.

The quality and quantity of purchased school inputs and the efficiency of their utilization is only of indirect concern since, ultimately, parents and voters in a school district care about student learning and achievement. Thus, in the production of public education (as in most public services), it is essential to distinguish between the direct services or the activities engaged in by a government and the outcomes of interest to voters and citizen-consumers of public services. In determining these outcomes, parental background and student characteristics play a crucial role in the translation of purchased school inputs into student achievement.

The above discussion, reflects the perspective of the seminal article by Bradford, Malt and Oates (1969) where public sector service provision is conceptualized by distinguishing activities directly produced by the government from services actually consumed by a citizen-consumer. Combining this framework with the importance accorded non-school inputs over the last several decades of education research (Hanushek, 1986), results in an approach to modeling production which fits the educational process. Student achievement (S) is a function not only of school output or activities (G) produced from purchased inputs, but also of non-purchased factors (E) that affect the efficacy of converting school activities into student achievement. We label these non-purchased inputs as (E) "environmental" factors because they reflect the stringency of the educational environment faced by school personnel. These environmental factors can include physical factors (P), family background (F) and student characteristics (ST);

$$\begin{aligned} S &= h(G, E) \\ \textit{where,} & \\ E &= g(P, F, ST) \ . \end{aligned} \qquad \textbf{(2)}$$

The physical characteristics (*P*) of a school district can have an important influence on the effectiveness of a given amount of other school inputs. For example, the number of students in a district (*N*) will affect the student achievement produced from a given level of school activities. While school resources do not necessarily have to increase proportionally with a rise in the student population to maintain the same level of student achievement, in the absence of improved productivity some increase in resources is needed. The importance of family background (*F*) on student achievement has been confirmed in many studies since the Coleman Report (1966). The key characteristics of family background which appear to affect educational achievement include physical, educational and parental resources and parental expectations. Children growing up in low income households not only have fewer physical resources but often lack parental guïdance, assistance, and encouragement regarding schoolwork and face low expectations by teachers regarding their future academic prospects.[5]

Among environmental factors, student performance may also be affected by differences in student characteristics (*ST*). Ideally, models of student achievement would control for differences in the innate ability and motivation of students so that the impact of schools on student achievement could be isolated. Given the difficulty of separating the effects of heredity and the environment on human behavior in general and on cognitive attainment in particular, it is not surprising that presumptive measures of innate ability, such as IQ tests, have been highly controversial. While it is not possible to allow fully for innate ability in accounting for variations in student performances, it is feasible to control for the prevalence of students with special needs (handicaps, learning disabilities) and those with limited English language proficiency.

The final "production function" for educational services takes into account differences in the resources provided by schools and other non-purchased factors. Specifically, substitution of equation (1) into equation (2) gives an implicit production function for education;

$$S = h(G, g(P, F, ST)) \quad . \tag{3}$$

This production function serves as the basis for deriving a cost model and measures of economies of scale.

Public Sector Costs and Economies of Scale

Over the last several decades, an extensive literature on the determinants of local public expenditure has evolved. For our purposes, however, it is essential to distinguish between actual or reported spending for a particular public service and the costs of providing the service. As applied to local schools, the term "costs" refers to the amount of expenditure or outlay needed by a district to provide specified levels of educational attainment or outcome and not actual observed expenditure. In other words, costs are the value of the resources consumed in the production of a given level of student achievement. In production theory, a standard production function such as that in (1) above can be solved for its implicit cost function;[6]

$$TC = c(G, W) \quad , \tag{4}$$

where W represents resource prices and TC is total costs.

Besides the cost of production, school district expenditure reflects variation in many factors, particularly those related to the demand for education, such as district fiscal capacity and indicators of preferences for schooling. Thus, it is important when using expenditure data to make cost comparisons between school districts of different sizes to control for variation in factor prices (e.g., teacher salaries), student and family characteristics, the level of student achievement and demand for educational services. Utilizing the production framework that was discussed previously, the standard cost function

can be modified to fit educational production. Specifically, if equation (3) is solved for G and substituted into equation (4), the modified cost function is;[7]

$$TC = c(h^{-1}(S, g(P, F, ST)), W) , \quad (5)$$

where the physical factors (P) include the number of students (N).

Equation (5) provides a flexible form for bringing educational outcomes, student population, environmental variables, and factor prices into an analysis of public production. This approach has several advantages. The dependent variable, whose cost is being explained is the cost of service outcomes (i.e., achievement test scores), for which some measures exist, rather than the cost of school activities whose quantities are so difficult to measure. The approach also leads directly to clear definitions of economies of scale in the public sector. By controlling for differences across districts in student achievement, environmental factors and factor prices, this cost function yields estimates of economies of scale that more appropriately indicate the effects of variation in size than those frequently estimated with lesser controls for cost factors other than district size.

In the empirical analysis presented below the coefficients of the cost function are determined from estimating an equation in which expenditure is the dependent variable. However, as a result of including demand side variables as well as student outcomes in this equation the coefficients for the cost factors can be used to derive the desired cost function indicative of economies of scale.

The concept of economies of scale relates costs to differences in output levels. Economies or diseconomies of scale are revealed in the relationship between average cost (cost per unit of output) and the level of output. This relationship is more complicated for services than for goods and is particularly complex for services produced in the public sector. Scale effects in the public sector can be conceptualized along three separate dimensions or elements; the quality of the public service (S), the level of governmental activity (G), and the number of people served (N). Each of these dimensions has

potential for economies or diseconomies. For service outcomes (S) the scale question is whether increasing the quality of the service consumed by an individual citizen/consumer entails greater or less than proportionate increases in cost. For governmental activities (G) the parallel, yet distinct, question is whether producing another unit of the activity requires more or less than proportionate change in cost. Finally, as regards the number of people served (N), the of scale issue primarily relates to the degree of rivalry or congestion in consumption. To maintain a given level of service quality per capita within a jurisdiction, what increases, if any, in cost are associated with larger numbers of citizens within the jurisdiction?

While all three dimensions of scale in the provision of public services are important conceptually and practically, the primary emphasis of policy as regards scale economies in local schools is the size of school districts and potential for cost saving through district consolidation. Consequently, we focus simply on the relation of cost to the number of people served. In education, pupils per district is the appropriate indicator of the service population. The relation of per pupil expenditure, TC/N, to the number of pupils, N, is one of the most heavily studied areas of education research. There are literally scores of studies that have examined how per pupil expenditure changes when student populations increase. Fox (1981) indicates that there has been significant variation in results although most studies find scale economies over some range of enrollment. Many of these differences result from the cost models' improper controls for service quality, student and family characteristics and demand factors. Research on education costs also indicates the importance of distinguishing economies of size among different types of costs (e.g., administrative versus instructional).[8] The scale definitions developed here provide guidance on which classification of costs we expect to exhibit decreasing costs and why.

We define "economies of size" as the percent difference in *TC/N* with respect to a one percent difference in *N*, controlling for student achievement, *S*, and environmental cost factors, *E*. Using equation (5), this elasticity can be expressed as:

$$\frac{\partial\left(\frac{TC}{N}\right)}{\partial N}\ \frac{N}{\frac{TC}{N}} = \left(\frac{\partial TC}{\partial G}\ \frac{G}{TC}\right)\left(\frac{\partial G}{\partial N}\ \frac{N}{G}\right) - 1 \equiv \theta_1\theta_2 - \qquad (6)$$

Economies (diseconomies) of size exist if this expression is less than (greater than) zero. Economies of size imply that per pupil costs can be reduced by expanding the student population, in other words, consolidation may reduce per pupil costs.

Equation (6) depicts a major advantage of this approach; it permits decomposition of sources of economies of size. The first elasticity, θ_1, which we call technical economies of scale, represents the relationship between costs and quantity of school activities. It is the measure most closely associated with the definition of economies of scale in goods production in that it depicts the technical relationship between the amount of intermediate output of government (G) and the quantity of inputs needed to produce it. Most activities performed in the production of education are labor intensive so that an increase in activities requires a proportionate increase in labor inputs leaving little opportunity for technical economies of scale except possibly for capital expenditure for buildings and transportation.[9] Per pupil transportation costs may decrease over some range but are likely to begin increasing with size as students may have to be bussed longer distances to central schools.

The other elasticity, θ_2, captures the relationship between government activity (G) and student population (*N*). To maintain per pupil service levels, do government activities have to increase in direct proportion with the number of pupils? Specifically, θ_2 measures how much additional *G* is needed to maintain a given level of *S* when the number of people served increases, controlling for the impact of

other "environmental" factors. If classrooms are operating at below capacity, it is probable that a one percent increase in students will require less than a one percent increase in instructional resources to maintain the same level of student achievement. However, if classrooms are already overcrowded, then an increase in the student population may require an equiproportionate increase in instructional resources.[10] Administrative costs best exemplify this type of decreasing costs since central administrative staff and resources presumably can be shared among a number of students, so that higher enrollments should be associated with lower per pupil administrative costs.

School district consolidation may reduce per pupil costs either because of technical economies of scale or nonrivalry in the use of some educational resources. However, consolidation may reduce allocative efficiency if households tend to sort themselves into school districts which provide a level of education close to what they demand. By consolidating smaller school districts, the level of service provided by the combined district (presumably some weighted average of the individual districts) may be less apt to match the demand of households. Ideally, a study of consolidation would weigh the efficiency gains from consolidation against the potential losses in allocative efficiency (Fisher, 1987). Because allocate efficiency losses are very difficult to estimate, they were not included as part of this study.[11] However, such losses should be considered in any final decision made about school district consolidation.

Empirical Analysis

To apply this approach to examine economies of scale and consolidation in education, we estimate our cost model for 610 of the 696 operating school districts in New York State in 1990.[12] As discussed previously, New York has taken an active interest in local government consolidation. In fact, the number of school districts in the state has fallen from over 11,000 districts in the late 19th century to approximately 700 districts today. Most of this decrease, however, took place before 1970. Recently

the Commissioner of Education proposed examination of district reorganization as a means of improving district efficiency and reducing school costs to local and state governments (Sobol, 1992). The proposal specified candidate districts for consolidation and our analysis of economies of size are used to evaluate the Commissioner's list and to target districts which are most likely to experience cost savings through consolidation. This section describes our measures, data sources, and results.

Measures and Data Sources

Output/Outcomes. A fundamental data issue is the need for measures of educational outcomes. The New York State Education Department collects a variety of school "outcome" measures each of which has its limitations as an indicator of student achievement. Few of the tests utilized are designed to test comprehensive achievement for all students at a particular grade level or to provide a picture of overall progress over several grades.[13] The major achievement test required for elementary students are the Pupil Evaluation Program (PEP) tests where math and reading are tested in the third and sixth grades. District level PEP test performance is measured as the percent of students above a minimum level of performance called the "standard reference point." Students falling below this level are eligible for special assistance.[14] The proportion above the standard reference point is our measure of educational outcomes in elementary grades.

For secondary education, the only common achievement tests administered in New York are the Regents Examinations. Since Regents tests are not required to be taken by all students, this study measures secondary school outputs as the percent all pupils in the appropriate grade who pass the examination. Another indirect measure of school performance used in this study is the student dropout rate, indicative mainly of outcomes in secondary grades.

Table 1 compares outcome measures across districts of different size. Interestingly, the smallest districts display average performance on the PEP test, lower than average dropout rates but a below

average percent of students passing the Regents exams. This later finding is due primarily to the lack of Regents preparatory classes available in smaller districts which tends to discourage students from taking these examinations. Overall, the highest performance is in districts between 1,000 and 5,000 pupils, a range which captures most suburban districts.

Input Prices. Expenditure data do not control for differences in resource prices across school districts. Resource prices should measure costs per unit of a given quality of important inputs purchased by school districts. While prices for items such as school supplies are directly available and are not likely to vary across districts, there is no ready source for variations in quality adjusted costs of the main school inputs, teachers and school capital facilities. To deal with this problem measures of teachers' salaries and capital costs were constructed for this study. A teacher salary index was estimated which adjusts teacher salaries for differences in teacher experience, education and certification.[15] School districts utilize both capital equipment and facilities in the production of education. Since these resources have a life beyond one year, what is wanted here is a measure of the costs of obtaining the flow of school services which emanate from the stock of capital. To serve this purpose we constructed a measure of the annual cost of capital. The measure used here reflects differences both in the interest rates faced by school districts (due to differences in bond ratings) and in construction costs among districts.[16] Comparing districts of different size in terms of these resource prices, smaller districts tend to have the lowest costs of capital and teacher salaries. This difference primarily reflects geographic location, since most of the largest districts are located in the New York City metropolitan area where acquisition of property and construction is costly, and high costs of living lead to higher teacher salaries.

Environmental Costs. Table 1 also presents a range of environmental cost factors which affect the transformation of school activities into student achievement.[17] Physical factors include pupil

density and the median sized elementary school in a district, variables which reflect sparsity of students in a district and the extent of centralization of district schools. Included among family background factors are the poverty rate in the district and the percent of nonwhite students. Student characteristics encompass the percent of students with limited English proficiency, handicapping conditions and the relative proportion of high school students. In general, the smallest districts have above average poverty rates and sparsity, but below average numbers of students with special needs. Not surprisingly, the large central city districts face the harshest educational environment with high proportions of poor and minority students and those with handicapping conditions.

From Expenditure to Costs. Data on district level expenditure from the New York State Comptroller are used as the basic dependent variable from which estimates of educational cost are derived. Expenditure, however, measures actual spending, not the underlying cost of providing a given level of educational services. To permit the statistical relationship between cost factors (see factors specified in Table 1) and expenditure to be interpreted as indicative of such costs, it is essential to control for factors other than costs which also influence spending. The most important such other factors are those affecting district demand for education, particularly measures of fiscal capacity.[18] We expect that greater fiscal capacity, as measured by district wealth and state aid, will lead to higher demand for education and for education spending. In general, per pupil expenditure declines from the smallest districts to those between 1,000 and 2,500 in size and then begin to increase again. These expenditure differences are consistent with differences in fiscal capacity since the smallest districts have the highest district wealth per pupil and the largest districts receive more state aid per pupil.[19]

Results of the Cost Model

The cost model in equation (5) is estimated using a cross-section of 610 school districts in New York in 1990. Traditionally, cost models have been estimated with a mean regression technique such

as OLS which essentially assumes that the providers of the service use all inputs efficiently. In reality, inefficiencies may exist that, if systematically associated with independent variables, would affect the coefficient estimates. To test for this, the cost model was estimated by both OLS and a stochastic frontier method.[20] Since the results reported in Table A-1 in the appendix indicate relatively small differences in estimates between these methods, OLS coefficients are used to calculate the scale effects.

Table 2 reports the OLS coefficients for per pupil total expenditure and expenditure on instruction, transportation, operating and maintenance, and central administration.[21] To control for differences in service quality among districts, five outcome measures are included in the final cost model. Better outcomes (i.e., higher student achievement) should be associated with higher costs holding the other cost factors constant and dropout rates should be negatively related to costs. The results reported in Table 2 generally fit these expectations, but only the Regents scores and the dropout rate are statistically different from zero.

To capture the effects of size, the model includes the number of pupils (average daily attendance) and pupils squared to allow for the possibility of a nonlinear relationship between costs and enrollment. If economies of size exist in a district, we would expect larger pupil size to be associated with lower per pupil costs, holding service quality constant. As discussed in the next section, the coefficients for the linear and squared pupil variables indicate a "U-shaped" cost function, implying both economies and diseconomies of scale over certain ranges in enrollment.

Other aspects of district scarcity are reflected in the model by inclusion of pupil density (pupils per square mile) and the median size of elementary schools. Some cost savings could result from the more efficient size of school buildings, so that the presence of larger elementary schools may also be associated with lower costs. Pupil density in a school district may have several effects on costs. For transportation, pupil density should be negatively related to cost as the distance buses have to travel to pick up one more student should decrease with higher density. For non-transportation costs, pupil

density may serve as a proxy for urbanization. Higher density districts are predominantly located in urban areas where family background characteristics associated with higher costs also predominate. Generally, the results reported in Table 2 fit this pattern. The presence of larger elementary schools is generally associated with lower per pupil costs even holding service quality constant. The coefficient for the pupil density measure varies by type of cost; it is negative for transportation costs and positive for the other cost categories.

As discussed previously, two measures of resource prices were constructed for this analysis, a teacher salary index and an index reflecting capital equipment and facility costs. As expected, both of these price measures are positively related to costs. The capital price variable demonstrates particularly strong effects; a one percent increase in capital costs relative to the state average is associated with a one percent increase in total per pupil expenditure.

Lack of availability of the 1990 *Census of Population* data for school districts, limits inclusion here of family background (*F*) variables only to the percent of students that are nonwhite and the poverty rate. High values of these factors are expected to raise the cost of providing a given quality of educational services. The coefficient for the non-white variable is positive as expected, but the coefficient on the poverty rate is negative. The most likely explanation for the incorrect sign here is failure to control adequately for demand for education. That is, the negative coefficient for poverty indicates insufficient allowance for the association of high poverty rates with low fiscal capacity as well as with low values for other indicators of demand for schooling.

The model includes several measures of student characteristics (*ST*) which are presumed to affect costs. Ratcliff, Riddle and Yinger (1990) found that the percent of handicapped students and secondary students were strongly related to per pupil expenditure. In addition, the large number of recent immigrants living in the urban areas of New York imposes the cost impact of students with

limited English proficiency. As expected, each of these variables is positively associated with per pupil expenditure and statistically significant from zero. A one percent increase in the relative number of handicapped students, those with limited English proficiency, or of high school students is associated with higher per pupil total costs of .68, .97 and .45 percent, respectively. In summary, the results of the cost model generally fit expectations about the nature of educational production and provide indications of the magnitude of the effects of factors affecting the cost of providing education in New York State.

Analysis of Economies of Size

No aspect of the provision of services in the public sector has received more attention than the relationship between costs and size of the population of the jurisdiction served. Interest in economies of size stems from its close link to the policy issue of jurisdictional reorganization including consolidation. This issue has had a greater impact on school districts than on any other type of jurisdiction in the United States with numbers declining from over 67,000 in 1952 to under 15,000 in 1987. New York State has actively encouraged consolidation of small school districts and local governments. However, there is relatively little evidence on the cost savings from such consolidation. Existing analyses are based primarily on a small number of case studies, and the results generally show no reduction in total expenditure per pupil in the first few years after consolidation. Long term results are extremely difficult to ascertain from case studies because over time many other changes occur that confound identification of net effects of consolidation. The analysis in this section provides evidence on variation in total per pupil costs and in costs of broad components of school spending in relation to the size of school districts in New York.

Results for economies of size presented in this study are based on the cost model discussed previously. The coefficients for the pupil variables (the natural log of average daily attendance and the square of this variable) are utilized to estimate scale economies. The specific method estimates how

costs change as enrollment varies when all variables other than pupil numbers are held at the state average. Separate analyses are carried out for total costs and for each type of cost.[22]

As illustrated in Figure 1, per pupil total costs decline as the number of pupils served increases, but the cost curve flattens out very quickly. Per pupil costs drop from $11,600 for districts with 50 students to $8,200 for an enrollment of 500. From this size, costs continue to decline slowly until they reach the minimum of $7,200 at an enrollment of 6,500 (Table 3). Above this level, costs begin to rise slowly, reaching $7,800 by an enrollment of 50,000. Costs exclusive of overhead costs decline more steeply with size so that the cost minimizing enrollment level falls to 2,500.[23] Over eighty percent of this cost decrease occurs by an enrollment of 500 pupils. In general, *instructional* costs exhibit a similar pattern with ninety percent of cost decreases occurring by an enrollment of 500 and the cost minimizing enrollment level falling to 1,700.

The pattern for the other types of costs generally fit expectations (Figure 2). Per pupil *administrative* costs drop sharply from $1,100 per pupil in tiny districts to $300 per pupil in a district with 500 pupils. These costs continue to decline as enrollment increases but at a decreasing rate. *Transportation* costs, on the other hand, exhibit a classic U-shaped pattern. Controlling for district area, per pupil costs drop by 25 percent from an enrollment of 50 to cost minimizing enrollment of 1,100 pupils. Above this level costs begin to rise becoming higher in districts of 50,000 than in those with 50 pupils. In contrast, *operating and maintenance* (O&M) costs per pupil are relatively constant with the coefficients on the pupil variables not statistically significant from zero. The median size district in New York has 1,500 pupils and operates in the range of slight economies of scale for total and administrative costs and close to the bottom of the average cost curve for the other cost categories.

The cost model also allows examination of potential diseconomies of scale associated with large city districts. Total costs increase by only 9 percent ($600 per pupil) from the cost minimizing

enrollment (6,500 pupils) to the largest district in the sample (50,000 pupils). (This compares to an increase in costs of 60 percent from the cost minimizing point to a district with only 50 students.) Most of the diseconomies are associated with instructional and transportation costs which are 23 and 45 percent higher at 50,000 pupils than at the cost minimizing enrollment. The issue of breaking up large city districts has received attention recently because of decentralization proposals in Los Angeles. The evidence in this study does not indicate a major percent decrease in costs from such reforms; however, because of the size of many city districts there could be sizeable absolute savings. **Small District Analysis**

Technical Efficiency and Equity. The scale results estimated for New York school districts reveal how education costs change as district enrollments increase. Districts with moderate enrollments do appear to have significantly lower per pupil costs than districts with very low enrollment. Administrative costs, in particular, appear to demonstrate significant economies of size. However, the principal cost savings of increased enrollments are exhausted by the time a district reaches an enrollment of 500 to 1,000 pupils. In fact, there may be diseconomies to expanding district enrollment beyond 5,000 pupils.

Studies of municipal consolidation have identified two principal reasons for promoting consolidation: technical efficiency and equity (Mullins, 1989). The efficiency (cost savings) argument is based on the potential for economies of size in government operation.[24] Elimination of duplication in administrative and support services is often cited. Realization of such cost savings requires elimination of redundancy in staff, facilities and equipment. The record on municipal consolidation reveals that these economies are seldom realized because governments are unwilling to cut staff and facilities (Gustely, 1977).[25] Second, consolidation is advocated as a means for fiscal and social equity in service provision. Particularly in the context of metropolitan areas, consolidation is promoted as a

mechanism for central cities sharing in the tax base of their wealthier suburbs. Tax base sharing, however, can take place without full consolidation of local jurisdictions through metropolitan or county-wide taxation and revenue sharing while maintaining the local control of expenditure decisions and operation of services. In effect, state-wide tax base sharing occurs through use of a redistributive tax and grant-in-aid system.[26] In dealing with horizontal equity among school districts, New York State has relied on state aid as opposed to tax base sharing. Incentives for district consolidation have been provided to improve technical efficiency rather than to deal with fiscal inequities. Neither grants nor tax-base sharing short of service consolidation promote integration of students of different backgrounds. To the extent that peers influence school performance and contact enhances social cohesiveness and tolerance for differences, school district consolidation may yield important social benefits.[27]

Proposals for District Consolidation. The Commissioner of Education in New York recently initiated a review of district reorganization and provided a detailed list of candidate districts. As regards the objective of cost reduction through efficient-size of districts, our analysis suggests consolidation efforts should be concentrated primarily on districts with enrollments below 500 pupils. There are roughly 90 such districts in New York, although, only 44 of them are on the Commissioner's candidate list.[28]

Which of the 90 districts with 500 or fewer pupils offer cost genuine opportunities for cost savings from full or partial consolidation? The next step in our analysis is to narrow the list to districts which realistically may experience some potential cost savings from reorganization. For each of these districts, we examine land area, sparsity (pupil density) and actual per pupil expenditure. Districts considered primary candidates for full consolidation with another district are those with relatively small land areas and low sparsity (relatively high pupil densities). What about the group of sparely populated rural districts usually proposed for consolidation? Analysis shows that little instructional, operating or transportation cost savings are likely to result if two geographically large, sparsely populated districts

are merged. Benefits, however, may ensue if such districts share administrative expenses and support services. The final step is to identify potential pairs of districts which might benefit from some form of reorganization. Districts for which there was no logical pairing were dropped from the list of candidates.

The results of this analysis are summarized in Table 4. Districts are identified which potentially might reduce costs through either full consolidation or sharing of administrative costs (administrative consolidation). Seventeen small districts emerged as suitable for consideration for full consolidation. Interestingly, most (14) are in suburban counties. These districts generally are geographically small, have above average district wealth (CWR) and adjoin a city. While the historical reasons for the existence of these small districts undoubtedly varies, they do not exist out of geographic necessity. Rather, they enjoy a favorable tax base and/or low minority or poverty student population. Consolidation of these districts with city districts could be justified on both efficiency and equity grounds, but the benefits to city residents are likely to be minor given the small size of the suburban district.

Table 4 also identifies 43 districts with under 500 pupils as candidates for administrative consolidation. These are mainly in rural counties and most are relatively large and sparsely populated. It is unlikely they could significantly reduce transportation, instructional or operating costs by fully consolidating services. Instead, cost savings could be achieved through the sharing of such centralized resources as administration or support services. Shared services would vary from district to district, and further study appears warranted. More controversial is whether such districts should consider full consolidation. As regards this decision, it is clear that the creation of large consolidated schools that can offer a wider variety of subjects and programs is not a potential benefit of consolidation of this group of schools. Extra travel costs and time in geographically large, population scarce districts preclude such benefits. Distance learning utilizing modern interactive telecommunications is called for

in these circumstances. However, if these districts maintain two school boards, superintendents and sets of central support staff, then it is not clear how much savings will be realized from administrative consolidation. Initiatives to promote full consolidation of such districts must balance the potential administrative cost savings with the loss of local control and accountability. The potential gain in technical efficiency due to consolidation may be countered by losses in allocative efficiency.

Conclusions and Policy Implications

The cost model estimated in this study indicates that per pupil costs fall as enrollments increase controlling for other factors affecting costs. Eighty percent of the reduction occurs by the time a district size of 500 pupils is reached. Particularly important are potential cost savings in administrative costs and to a lesser extent in instruction and transportation. Our findings suggest that states interested in studying possible reorganization of school districts for efficiency reasons, should focus their attention on districts with 500 or fewer pupils.

With 500 pupils as the cutoff point, we identified 90 school districts in New York State which might be candidates for some form of consolidation. Using information on geographic size and sparsity and availability of good road infrastructure, this list was further narrowed to potential candidates for full consolidation and those sparsely populated districts that might benefit from sharing of administrative expenses and support services. We identified only 17 school districts in New York which might be considered for full consolidation. Interestingly, most of these districts are not rural districts but suburban districts which have above average wealth. In addition, 43 other districts showed indications of benefitting from sharing of administrative costs with a neighboring district. Most of these are in rural counties, are of above average geographic size and have very low pupil density.

The methodology developed in this paper should help state education officials to identify potential candidates for consolidation and estimate the potential cost savings from consolidation. In

the case of New York, what are the financial benefits of consolidation of the sixty districts identified in our analysis? Assume, to be optimistic, full consolidation will save $4,000 per pupil annually and that administrative consolidation $800. Based on average enrollment for these districts, maximum cost savings would be approximately $27.5 million per year. While this is not trivial, it pales in comparison with the $20 billion budget of New York school districts and the $8 billion in state aid for public education in 1990. To encourage this .001 percent reduction in school district costs, New York State is willing to give generous additional state aid such that the state conceivably could spent an additional $.22 in state aid for every $1.00 in **potential** cost savings.[29] Although the potential savings from consolidation are not significant in New York, this may not be the case in other states. Riddle, Ratcliff and Yinger (1990) found, for example, that approximately 60 percent of the school districts in Nebraska served 100 or fewer students. In this environment, the potential cost savings from consolidation could be substantial.

While not a central focus of this paper, the cost model has provided some evidence on diseconomies of scale. The percent increase in total per pupil costs from the cost minimum size to a district of 50,000 pupils is nine percent. While the proportionate increase is not large, the absolute potential cost savings of decentralizing large school districts could be significant. If, through decentralization, the six school districts in the sample above 10,000 pupils could lower their costs to the minimum, the maximum potential cost savings would be over $40 million, more than the potential savings from consolidation. While the actual cost savings are likely to be much smaller, these results suggest that states should pay equal attention to diseconomies of scale.

The economies of size results estimated in this paper indicate that small districts do confront sizeable cost impacts due to scale inefficiencies. When consolidation of small districts may not be feasible or cost-effective, state governments should consider adjusting the distribution of state aid to allow for the higher costs imposed by small district size.[30] The cost model developed in this study

permits development of an educational cost index which can be used, along with data on school district fiscal capacity, to distribute aid among districts. Table 5 reports the estimated cost indices by district pupil size when district size is controlled for and when it is not.[31] Not surprisingly, the impact of controlling for district size has a significant impact on the cost index of particularly small districts. Cost in districts of 500 or fewer pupils is 11 percent above the state average when scale is adjusted for, but 8.1 percent below average when it is not. In general, smaller districts would be the prime beneficiaries from such an adjustment.

The objective of this paper has been to develop a methodology for estimating the economies of scale in schooling and applying it to measure the potential cost saving from school district consolidation. Development of a comprehensive model of school district costs enables us to examine how costs change as school district size varies, holding other important cost factors constant. Application of the methodology to school districts in New York reveals potentially sizeable cost savings from consolidation of school districts with 500 or fewer pupils, but practical difficulties for full consolidation due to geographical considerations. While these findings apply directly to New York, the method developed in this study could be valuable to state education policy makers in other states by helping to target candidate school districts, and, where consolidation is not feasible, adjusting state aid formulae to reflect more accurately the cost impacts of scale.

Endnotes

1. According to recent estimates from the U.S. Bureau of Economic Analysis, the total state and local government deficit removing social insurance funds was over $35 billion in both 1990 and 1991, 6 percent of own-source revenue (Sullivan, 1992).

2. Specifically, the state contributes an additional 40 percent in formula operating aid (*Incentive Operating Aid)* to consolidated districts for five years which is then phased out slowly over another nine years. *Incentive Building Aid* provides an additional 30 percent in Building Aid for capital projects which are committed within 10 years of reorganization (Sobol, 1992).

3. For a thorough literature review of studies of economies of scale in education, see Fox (1981). In general, most studies find a U-shaped average cost function (see, for example, Cohn, 1968 and White and Tweeten, 1973); however, the cost minimizing enrollment often varies. In addition, there are some studies showing constant returns to size (Kiesling, 1967 and Jimenez, 1986) or economies of scale (Shapiro, 1973 and Kumar, 1983).

4. There is an extensive literature on the determinants of student achievement and education production. Our model borrows heavily from Bowles (1970), Boardman et al. (1979), Bridge et al. (1979), Cohn (1990), Hanushek (1979 and 1986), and Murnane (1983). We have also used the literature on local public expenditure as a guide in our analysis, especially Bradford, Malt and Oates (1969), Inman (1979), Turnbull (1986) and Duncombe and Yinger (1993).

5. Along with the impact of a student's family background and special needs on his or her own performance, these factors can also affect the performance of other students in a class. Education research examining the influence of peers on a student's educational achievement has found low achieving students clearly benefit from being in a mixed classroom but the impact of integrated classrooms on the high achievers is less clear (Henderson et al., 1977)

6. The duality between cost and production functions is based on cost minimization by producers (Varian, 1984). If technical and allocative inefficiencies exist, the mean regression estimates of the cost function may not accurately reflect production relationships on the frontier. Estimates of the frontier cost function are reported in Table A-1 in the appendix and indicate relatively small differences with OLS estimates.

7. The unit of analysis in this paper for modeling production and cost decisions is the school district. From the perspective of local school officials and state education policymakers, analysis of school district costs would be the most appropriate level for examining issues of consolidation. Another perspective to modeling education production is to incorporate parental decisions on how to allocate household resources to minimize the total cost of reaching a given level of achievement by their children. Such an approach would consider both school district costs and the opportunity cost of parental time spent on home education and transportation and how these costs vary with school district size.

8. The importance of separating instructional costs from transportation costs has been stressed in the research of Kenny (1982), Jimenez (1986), and Howard and Baritelle (1975). Kenny,

for example, argues that it would not be surprising, even for a cost minimizing district, to operate in the range of increasing returns to scale for instruction and decreasing returns to scale for transportation since the cost curves for these types of costs are different.

9. In principal, economies of scale with respect to student achievement (S) also be estimated from the cost functions represented by equation (5). The form of empirical production function used for equation (3), restricts the economies of scale with respect to G and S to be the same. For a more general treatment of the definition of economies of scale, see Duncombe and Yinger (1993).

10. The elasticity, θ_2, is called a "congestion parameter" and estimates of congestion have a long history in local public finance research (see Borcherding and Deacon, 1972 and Inman, 1979).

11. For an estimate of potential allocative efficiency effects from consolidation of several New York State school districts, see Greene and Parliament (1980). Besides allocative efficiency effects from consolidation, there may be an increase in technical inefficiency. Public choice theorists, such as Niskanen (1975), have argued that increased size of a jurisdiction will lead to bureaucratic inefficiency by raising the monitoring costs of public bureaucracies.

12. Due to missing observations the sample size was reduced from 695 to 610 school districts. Included in these omitted districts was New York City and one small suburban district with extremely high property wealth which were excluded because they are extreme outliers. These omitted districts are spread fairly evenly among regions of the state and an analysis of these missing observations does not indicate any serious biases from their exclusion.

13. The major data source for outcome measures is the "Comprehensive Assessment Report" (CAR) published by the New York State Department of Education. This data base, available on magnetic tape, includes outcome measures for all major achievement tests carried out by New York State.

14. PEP test performance was also measured using the average score and the impact on the cost model was minimal. The percent above the SRP was used because of fewer missing observations.

15. Salaries were adjusted using multiple regression analysis. Specifically, average salaries were regressed against average years of teacher experience, percent of male teachers and percent of teachers with advanced degrees, tenure, and permanent certification. These factors were then held at the mean and the regression residual is used to reflect variation in salaries. Data on teacher salary and characteristics are collected as part of a self reporting survey by all professional school staff in the state called the "Basic Education Data System" (BEDS). The personnel portion of this survey is available in the "Personnel Master File" on magnetic tape from the New York State Department of Education.

16. Borrowing from the literature on private investment (Jorgenson, 1974), the proper price of capital is the annual rental price of capital which can be modeled as; $P_k = V(q+r)$, where V is the purchase price of capital, q is the depreciation rate and r is the real interest rate. Using information on bond ratings, an estimate of real interest rates was constructed for each

district. Assuming half of the purchase prices were for equipment and half was for facilities, we used depreciation periods of 10 and 50 years, respectively. Finally, facility costs were adjusted with a building cost index to reflect differences in land values and construction costs between districts.

17. The majority of these environmental factors are available either in the "Institutional Master File" from the BEDS data, or in the "Fiscal Profile" both published by the New York State Department of Education. The land area data and property composition data is from the New York State Department of Equalization and Assessment.

18. The measure of wealth commonly used in aid formulae by New York State is the "combined wealth ratio" (CWR) which is measured as an index reflecting a weighted average of property wealth (50 percent) and adjusted gross income (50 percent). For a detailed discussion of school aid formulae used by New York State, see Miner (1991). Since CWR is used to distribute operating aid in New York, the state aid variable included in the model reflects only non-operating aid.

19. The measure of fiscal capacity used by New York, the combined wealth ratio, is significantly higher, on average, for the smallest school districts (under 500 pupils). This high average is due to several small suburban districts with high property and income wealth. As discussed in the small district analysis, several of these suburban districts are prime candidates for consolidation.

20. The stochastic frontier method, developed by Aigner, Lovell and Schmidt (1977), can be illustrated using a modified form of the cost function (5);

$$S = c(h^{-1}(S, g(P, F, ST)), W) + (\epsilon_1 + \epsilon_2) .$$

The error term, ϵ_1, can either be positive or negative and reflects random variation in the production frontier across school districts due to measurement errors, exogenous shocks or just random 'noise' in the data. The second error term, ϵ_2, is positive and captures the level of technical inefficiency. The model was estimated with MLE and the coefficients can be interpreted the same as for OLS, except on the frontier. Since this method requires that the distribution of ϵ_2 be set ex ante, the model was estimated for three distributions, a half normal, exponential and truncated normal distributions. The results for each method were quite similar with the half normal results reported in Table A-1. Deller and Rudnicki (1993) also have found that the coefficients from an OLS and stochastic frontier production model were quite similar.

21. The cost model is a modified form of the Cobb-Douglas model where the variables are either expressed as percentages or natural logarithms. The coefficients in this model are interpreted as elasticities. The regression results were checked for violations of the Gauss-Markov assumptions. Using a White test, it is not possible to reject the null hypothesis of constant variance. Intercorrelations between variables were examined and several of the environmental variables--students on welfare and receiving subsidized school lunch--were dropped from the model because they are strongly correlated with poverty. Finally, we examined residuals for non-linear relationships and have included the square of pupils in the

final model.

22. Since the potential for actual consolidation depends on the proximity of districts, we also estimated the cost model and economies of size for subregions in New York including rural school districts. The economies of size results found for the whole state generally apply to rural and suburban districts as well.

23. Overhead expenditure includes central administration of the school district and expenditure allocated to the school district from the Board of Cooperative Education System (BOCES). BOCES are regional centers established by the state to provide cooperative education and support services to school districts. Since this expenditure is already consolidated into regions, it was dropped from the analysis of school district consolidation.

24. Closely related to cost savings is the view that consolidation allows a broader range of educational services in small districts. For a given expenditure level, consolidated districts can provide a broader curriculum and higher quality instruction. This is just the flip side of the cost argument that consolidated districts can provide equal quality services at a lower cost than the individual districts.

25. Recent case study evidence on consolidation in New York confirms how illusive cost savings can be. For the five districts examined, consolidation does appear associated with a reduction in administrative costs, but overall costs did not decrease, at least in the short-run (Sobol, 1992).

26. See Reschovsky (1980) for an analysis of the one example of tax-base sharing in this country, the Minneapolis-St. Paul metropolitan area. This plan was promoted not only to encourage more equitable distribution of resources between governments in this region but to stimulate a more efficient land use pattern. Reschovsky found that the this consolidation was reasonably successful at reducing horizontal inequities but had little effect on patterns of economic development.

27. For a detailed equity and efficiency argument for the need to integrate city and suburban governments see Rusk (1993).

28. Five criteria were used for identifying candidates for school district consolidation; 1) lack of K-12 continuity, 2) reduced enrollment, 3) high overhead (non-instructional) expenditure, 4) high dependence on state assistance, and 5) high tax rates and low average wealth. The memorandum explains that the 139 districts identified are subject to further study by the New York Education Department (Sobol, 1992). The focus of our analysis is on districts where small enrollment size militates for consolidation. Criteria 1) and 3) above should encompass such districts, although as mentioned in the text the Commissioner's list is far smaller than ours. Criteria 4) and 5) primarily distinguish districts with low fiscal capacity where equity constitutes the motive for consolidation. One third of the districts on the Commissioner's list fit these two criteria. Our analysis does not attempt to identify adjacent districts whose consolidation would equalize substantial disparities in fiscal capacity or educational costs. What we do rather is to distinguish within the group of districts with potential gains from increased scale those where equity gains might also ensue. The remaining districts on the Commissioner's list fit criteria 2), reduced enrollment. Reduced enrollment, per se is not a

rationale for consolidation unless the district is small or poor. Instead, the district should be encouraged to "downsize" it facilities and staff to meet its lower enrollment.

29. This estimate is based on the assumption that consolidating districts receive the full 40 percent increase in operating aid and 30 percent increase in building aid available from the state. The increase in state aid under these assumptions would be approximately $6.25 million which is 22 percent of the maximum cost savings of $27.5 million.

30. On the one hand, additional state aid to sparser school districts would appear to be a subsidy to parents who choose to live in small school districts. However, if the objective of aid is to provide equal educational opportunity to children and consolidation is not cost effective, then adjustment of state aid formulas to reflect sparsity is appropriate. Fiscal capacity should be taken into account as well as costs in distributing school aid.

31. The results of the regression analysis reported in Table 2 are used to create the cost index. The coefficients of the regression model are multiplied by the actual observations for each district except for the fiscal capacity and service outcome variables which are held constant at the state average. In the index which adjusts for district size, the actual number of pupils for each district is used to calculate the index, while the other index holds pupils at the state average.

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Figure 1: Estimated Per Pupil Total, Instructional and Non-Overhead Costs, New York State School Districts At Different Pupil Levels

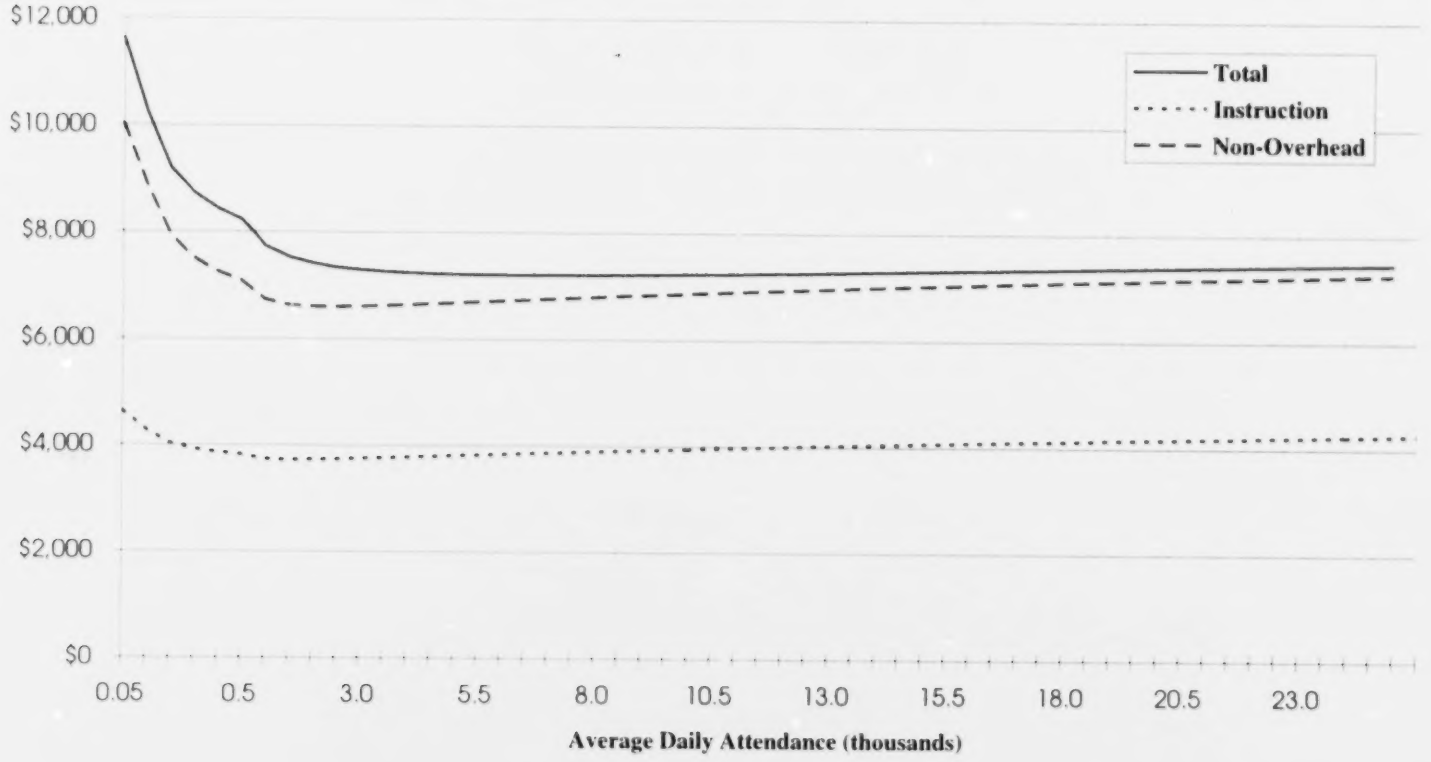

Figure 2: Estimated Per Pupil Transportation, Administration and O&M Costs, New York State School Districts At Different Pupil Levels

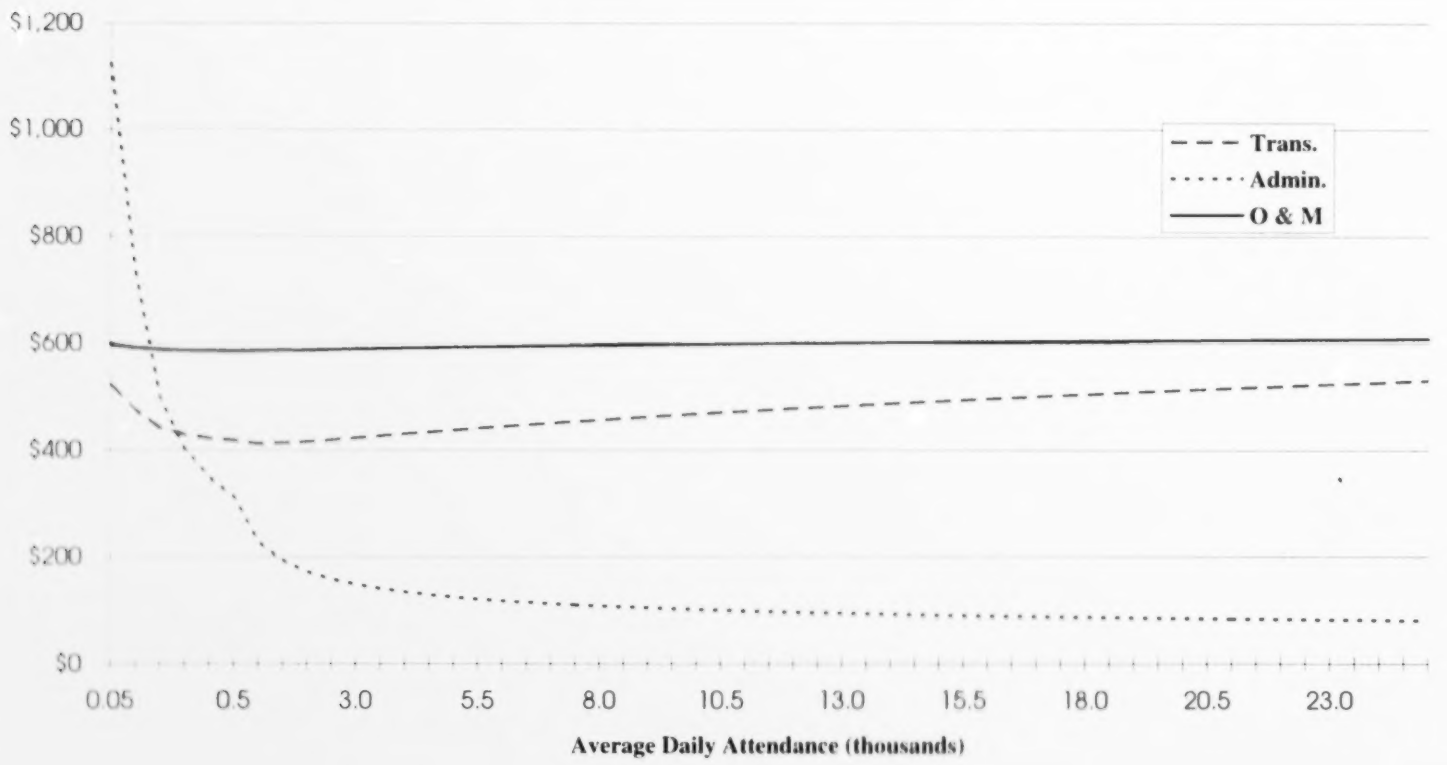

Table 1
Cost Related Characteristics of School Districts (Means)
By Student Population Size Category in New York State (1990)

School District Variables	Average Daily Student Attendance					
	Under 500	500-1000	1000-2500	2500-5000	5000-10000	Over 10000
Number of School Districts	78	105	248	118	55	6
Number of Pupils	315	730	1567	3405	6860	22367
PER PUPIL EXPENDITURE:						
Total Expenditure	$10,035	$7,572	$7,498	$8,268	$8,255	$7,316
Instructional	$4,009	$3,541	$3,794	$4,326	$4,436	$4,218
Transportation	$644	$477	$419	$464	$442	$436
Administration	$477	$248	$198	$182	$141	$112
Operating and Maintenance	$665	$556	$609	$690	$714	$594
EDUCATION OUTCOME MEASURES:						
6th Grade PEP Test						
(Percent Above Stand. Ref. Point)						
Math	97.5	97.5	97.6	97.1	96.7	94.2
Reading	93.3	93.1	92.2	92.4	91.2	87.3
Regents Exams						
(Percent of Enrollment Passing)						
Math-- Level 1	38.5	50.9	53.7	54.8	52.3	42.0
English	35.9	45.7	53.5	55.5	55.1	42.0
History	36.3	45.9	51.3	53.0	52.5	43.3
Chemistry	26.1	31.1	37.2	39.0	36.5	28.5
Biology	31.0	45.7	50.1	51.9	50.7	40.0
Dropout Rate (Percent)	1.8	2.7	2.9	2.9	3.7	5.9
RESOURCE PRICES:						
Teacher Salary Index	0.95	0.98	0.98	1.05	1.06	1.08
Capital Price Index	0.99	0.98	0.99	1.03	1.04	0.98
PHYSICAL FACTORS:						
Pupil Density	18.2	47.0	118.7	254.4	420.6	607.2
(Pupils per Square Mile)						
Median Elementary Schools	297.9	435.8	485.9	486.7	544.0	594.3
FAMILY BACKGROUND:						
Poverty Rate (percent)	15.0	13.4	10.1	8.1	9.4	14.8
Percent Nonwhite Pupils	3.7	4.0	6.4	13.3	17.5	32.7
STUDENT CHARACTERISTICS:						
Percent Limited English Proficiency	0.3	0.5	0.7	1.6	1.7	3.2
Percent Handicapped	10.2	10.8	10.6	10.8	11.2	12.4
Percent High School Student	0.3	28.1	29.1	29.5	29.3	26.6
DEMAND VARIABLES:						
Combined Wealth Ratio	1.8	0.8	1.0	1.1	1.0	0.8
Per Pupil Non-Operating State Aid	$6.97	$7.09	$6.93	$6.94	$7.03	$7.35

Sources: New York Department of Education, various sources and New York State Comptroller, Municipal Affairs, "School District Data Base".

Table 2
Factors Affecting School District Per Pupil Expenditure-- Regression Results
New York State (1990)

Variables	Total		Instruction		Transportation		Administration		Operating & Maintenance	
	Coefficients	t-statistics	Coefficients	t-statistics	Coefficients	t-statistics	Coefficients	t-statistics	Coefficients	t-statistics
Intercept	8.475	26.156	7.979	26.035	4.300	5.191	8.357	12.788	5.360	10.556
OUTCOME MEASURES:										
PEP--6th Math	0.029	0.140	-0.005	-0.026	0.170	0.320	0.207	0.493	0.088	0.270
PEP--6th Reading	0.057	0.477	0.044	0.391	-0.003	-0.008	-0.222	-0.931	0.133	0.717
Regents--English	0.049	1.510	0.148	4.835	0.000	0.000	0.235	3.592	0.172	3.382
Regents--Math I	0.067	1.825	0.157	4.519	-0.144	-1.533	0.079	1.069	0.127	2.209
Dropout Rate	-0.735	-2.393	-0.089	-0.306	-3.662	-4.666	0.260	0.420	-0.120	-0.250
RESOURCE PRICES:										
Teacher Salary Index	0.303	5.777	0.302	6.082	0.485	3.616	0.385	3.640	0.246	2.995
Capital Cost Index	0.977	11.128	0.781	9.408	1.810	8.063	0.735	4.152	0.842	6.121
PHYSICAL FACTORS:										
Pupils*	-0.354	-5.407	-0.269	-4.349	-0.355	-2.126	-0.893	-6.768	-0.038	-0.372
Pupils Squared*	0.020	4.626	0.018	4.414	0.025	2.293	0.033	3.805	0.003	0.432
Pupil Density*	0.016	2.585	0.020	3.521	-0.127	-8.256	0.041	3.355	0.028	2.954
Elem. School Size*	-0.072	-4.421	-0.072	-4.669	0.008	0.204	-0.047	-1.425	-0.163	-6.365
FAMILY BACKGROUND:										
Poverty Rate (percent)	-0.268	-2.474	-0.339	-3.311	-1.093	-3.950	-0.147	-0.671	-0.480	-2.830
Percent Pupils Nonwhite	0.142	2.322	0.229	3.955	0.567	3.615	0.193	1.564	0.295	3.066
STUDENT CHARACTERISTICS:										
Percent Limited English	0.974	2.611	0.954	2.704	0.693	0.727	3.075	4.086	0.608	1.040
Percent Handicapped Pupils	0.684	4.113	0.772	4.906	0.580	1.365	0.402	1.198	0.373	1.430
Percent High School Students	0.454	2.752	0.749	4.799	-0.222	-0.526	0.730	2.193	0.983	3.801
DEMAND VARIABLES:										
Combined Wealth Ratio	0.101	13.244	0.073	10.152	0.071	3.632	0.086	5.612	0.115	9.648
Non-operating Aid*	0.091	7.619	-0.006	-0.488	0.156	5.090	0.018	0.749	0.021	1.117
Adj. R2	0.791		0.796		0.436		0.711		0.673	
Sum of Squared Residuals	10.309		9.224		67.380		41.935		25.329	
Mean of Dependent Variable	8.946		8.238		6.047		5.304		6.377	

* The natural logarithm is used in the model.

Note: Estimated with OLS using a sample size of 610 school districts. The dependent variable is the natural logarithm of per pupil expenditure for each category.

Table 3
Per Pupil Costs Estimated from Cost Model
New York State (1990)

Type of Cost	District Student Population (Average Daily Attendance)									
	Median									
	50	300	500	1000	1500	2500	5000	10000	25000	50000
Total Costs	$11,619	$8,720	$8,227	$7,731	$7,522	$7,335	$7,209	$7,224	$7,461	$7,819
Instructional	$4,643	$3,920	$3,815	$3,735	$3,718	$3,729	$3,800	$3,942	$4,249	$4,589
Transportation	$523	$429	$418	$412	$413	$419	$438	$468	$530	$600
Operating & Maintenance	$597	$586	$585	$585	$586	$588	$592	$598	$609	$619
Administration	$1,124	$403	$313	$229	$193	$158	$124	$101	$80	$70
Non-Overhead	$10,036	$7,499	$7,080	$6,729	$6,628	$6,592	$6,672	$6,864	$7,264	$7,693

Note: Based on coefficient estimates from a log-linear cost model with quadratic population estimated with OLS. All variables held at the state average except for the student population. Non-overhead is defined as total expenditure minus central administrative expenditure and BOCES expenditure (see note 18).

Table 4

Characteristics of School Districts Considered For Consolidation, By Region and Type of Reorganization

New York Regions	Number of Candidate School Districts	Average Number of Pupils	Index Relative to State Average				
			Combined Wealth Ratio (CWR)	Pupil Density	Square Miles	Predicted Expenditure*	Actual Expenditure*
Candidates for Full Consolidataion:							
Suburban Districts	14	207	307	58	8	160	176
Rural Districts	3	334	52	7	51	119	103
Candidates for Administrative Consolidataion:							
Suburban Districts	10	232	407	7	38	165	203
Rural Districts	33	380	65	4	120	94	91

* There are missing observations for predicted values for eight districts. Averages for the index values for actual and predicted expenditures are based on the same sample.

Note: The combined wealth ratio (CWR), which is used as an indicator of fiscal capacity for state aid distribution in New York, is measured as an index reflecting a weighted average of property wealth (50%) and adjusted gross income (50%).

Sources: New York Department of Education, various sources.

Table 5
Cost Indexes by District Pupil Size Category
With and Without Adjustment for District Size
New York (1990)

Student Population Size Categories	Adjusted Cost Index	Non-Adjusted Cost Index	Percent Difference*
500 or less	111.2	91.9	21.01
500 to 1,000	96.6	93.1	3.81
1,000 to 2,500	95.7	98.1	-2.41
2,500 to 5,000	102.9	109.5	-6.01
5,000 to 10,000	103.4	112	-7.71
Over 10,000	101.7	107.9	-5.71

*Percent difference equals the adjusted index minus the non-adjusted index divided by the non-adjusted index.

Note: Index based on 610 school districts not including New York City. The index was calculated from a log-linear cost model with quadratic pupil population, estimated with OLS. To calculate the index the fiscal capacity variables and student achievement variables are held at the state average while the other cost variables are allowed to vary by district.

Table A-1

Comparison of OLS and Frontier Cost Regression Estimates
Total Per Pupil Expenditures in New York State (1990)

Variables	OLS Cost Regression		Frontier Cost Regression	
	Coefficients	t-statistics	Coefficients	t-statistics
Intercept	8.475	26.156	8.245	28.504
OUTCOME MEASURES:				
PEP--6th Math	0.029	0.140	0.034	0.168
PEP--6th Reading	0.057	0.477	0.018	0.132
Regents--English	0.049	1.510	0.061	1.918
Regents--Math I	0.067	1.825	0.082	2.426
Dropout Rate	-0.735	-2.393	-0.624	-1.881
RESOURCE PRICES:				
Teacher Salary Index	0.303	5.777	0.347	8.130
Capital Cost Index	0.977	11.128	0.965	11.579
PHYSICAL FACTORS:				
Pupils*	-0.354	-5.407	-0.313	-5.864
Pupils Squared*	0.020	4.626	0.018	5.025
Pupil Density*	0.016	2.585	0.016	2.805
Elem. School Size*	-0.072	-4.421	-0.695	-4.083
FAMILY BACKGROUND:				
Poverty Rate (percent)	-0.268	-2.474	-0.260	-2.883
Percent Pupils Nonwhite	0.142	2.322	0.152	2.329
STUDENT CHARACTERISTICS:				
Percent Limited English	0.974	2.611	0.877	2.840
Percent Handicapped Pupils	0.684	4.113	0.694	4.945
Percent High School Students	0.454	2.752	0.401	3.435
DEMAND VARIABLES:				
Combined Wealth Ratio	0.101	13.244	0.086	22.303
Non-operating Aid*	0.091	7.619	0.083	8.892
Cost Minimizing Enrollment	6,580		7,431	

* The natural logarithm is used in the model.

Note: The sample size is 611 school districts. The stochastic cost function is estimated in LIMDEP using the half normal distribution.